CLAIMS

1. A method comprising:

receiving a selected spatial multiplexing rate, the spatial multiplexing rate corresponding to one or more mapping permutations; and

for each of a plurality of data tones, mapping one or more of a plurality of data symbols to a plurality of antennas using a corresponding one of the one or more mapping permutations.

2. The method of claim 1, wherein the plurality of data tones comprise data tones in an OFDM (Orthogonal Frequency Division Multiplexing) symbol.

3. The method of claim 2, wherein said mapping comprises space frequency coding the OFDM symbol.

4. The method of claim 3, further comprising:

transmitting the coded OFDM symbol on the plurality of antennas.

5. The method of claim 1, wherein the plurality of mapping permutations comprise $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ mapping

permutations, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

6. The method of claim 1, wherein the spatial multiplexing rate is selected from a plurality of available spatial multiplexing rates corresponding to the number of antennas.

7. The method of claim 6, wherein the plurality of available spatial multiplexing rates comprise a pure diversity spatial multiplexing rate, a pure multiplexing spatial multiplexing rate, and one or more intermediate spatial multiplexing rates.

8. The method of claim 1, wherein the mapping permutations are applied to the plurality of data tones in a cyclical manner.

9. The method of claim 1, wherein said mapping comprising mapping with an apparatus compliant with a standard selected from the group consisting of IEEE standards 802.11a, 802.11g, 802.16, and 802.20.

10. The method of claim 1, wherein said mapping provides substantially maximum spatial diversity for the selected spatial multiplexing rate.

11. The method of claim 1, further comprising:

transmitting the plurality of data symbols from the plurality of antennas at a substantially equal power for each of said plurality of antennas.

12. The method of claim 1, wherein said mapping comprises mapping said one or more of the plurality of data symbols to the plurality of antennas for each of the plurality of data tones using less than a plurality of available tone-antenna combinations.

13. The method of claim 1, wherein said mapping comprises mapping the same mapping permutation to the plurality of antennas for a plurality of adjacent tones.

14. A method comprising:

receiving a space frequency coded symbol from a plurality of antennas, the space frequency coded symbol including a plurality of data tones,

wherein each data tone includes one or more of a plurality of data symbols mapped according to a corresponding one of one or more mapping permutations, and

wherein the one or more mapping permutations correspond to a selected spatial multiplexing rate; and

decoding the space frequency coded symbol.

15. The method of claim 14, wherein said decoding comprises decoding using a linear decoding process.

16. The method of claim 14, wherein said decoding comprises decoding using a non-linear decoding process.

17. The method of claim 14, wherein the space frequency coded symbol comprises a space frequency coded OFDM symbol.

18. The method of claim 14, wherein the plurality of mapping permutations comprise $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ mapping

permutations, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

19. The method of claim 14, wherein the spatial multiplexing rate is selected from a plurality of spatial multiplexing rates corresponding to the number of antennas.

20. The method of claim 19, wherein the plurality of spatial multiplexing rates comprise a pure diversity spatial multiplexing rate, a pure multiplexing spatial multiplexing rate, and one or more intermediate spatial multiplexing rates.

21. The method of claim 14, wherein the mapping permutations are applied to the plurality of data tones in a cyclical manner.

22. The method of claim 14, wherein said receiving comprises receiving with an apparatus compliant with a standard selected from the group consisting of IEEE standards 802.11a, 802.11g, 802.16, and 802.20.

23. The method of claim 14, wherein said receiving comprises receiving the space frequency coded symbol with

substantially maximum spatial diversity on the antennas for the selected spatial multiplexing rate.

24. The method of claim 14, wherein said receiving comprises receiving the space frequency coded symbol at a substantially equal power for each of said plurality of antennas.

25. The method of claim 14, wherein the space frequency coded symbol includes a plurality of data symbols mapped according to one of the plurality of mapping permutations for a plurality of adjacent tones.

26. An apparatus comprising:

a demultiplexer operative to demultiplex a plurality of data symbols in an input stream;

a mode selector operative to select a spatial multiplexing rate from a plurality of available spatial multiplexing rates, the selected spatial multiplexing rate corresponding to a plurality of data symbols and one or more mapping permutations; and

a coding module operative to space frequency code a symbol for transmission, said coding comprising, for each of a plurality of data tones, mapping one or more of the plurality of data symbols to a plurality of antennas using a corresponding one of the one or more mapping permutations.

27. The apparatus of claim 26, wherein symbol for transmission comprises an OFDM symbol.

28. The apparatus of claim 27, further comprising:

a transmission module operative to transmit the coded OFDM symbol on the plurality of antennas.

29. The apparatus of claim 26, wherein the plurality of mapping permutations comprise $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ mapping permutations, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

30. The apparatus of claim 26, wherein the plurality of available spatial multiplexing rates comprise a pure diversity spatial multiplexing rate, a pure multiplexing spatial multiplexing rate, and one or more intermediate spatial multiplexing rates.

31. The apparatus of claim 26, wherein the coding module is operative to apply the mapping permutations to the plurality of data tones in a cyclical manner.

32. The apparatus of claim 26, which is compliant with a standard selected from the group consisting of IEEE standards 802.11a, 802.11g, 802.16, and 802.20.

33. The apparatus of claim 26, wherein the code module is operative to space frequency code the symbol to provide substantially maximum spatial diversity for the selected spatial multiplexing rate.

34. The apparatus of claim 26, further comprising:

a transmit module operative to transmit the symbol from the plurality of antennas at a substantially equal power for each of said plurality of antennas.

35. The apparatus of claim 26, wherein the code module is operative to code the symbol using less than a plurality of available tone-antenna combinations.

36. The apparatus of claim 26, wherein the code module is operative to map one or more of the plurality of data symbols to the plurality of antennas using the same mapping permutation for a plurality of adjacent tones.

37. An apparatus comprising:

a receiver operative to receive a space frequency coded symbol from a plurality of antennas, the space frequency coded symbol including a plurality of data tones,

wherein each data tone includes a plurality of data symbols mapped according to a corresponding one of one or more mapping permutations, and

wherein the plurality of data symbols and the one or more mapping permutations correspond to a selected spatial multiplexing rate; and

a decoder operative to decode the space frequency coded symbol.

38. The apparatus of claim 37, wherein the decoder comprises a linear decoder.

39. The apparatus of claim 37, wherein the decoder comprises a non-linear decoder.

40. The apparatus of claim 37, wherein the space frequency coded symbol comprises a space frequency coded OFDM symbol.

41. The apparatus of claim 37, wherein the plurality of mapping permutations comprise $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ mapping permutations, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

42. The apparatus of claim 37, wherein the spatial multiplexing rate is selected from a plurality of spatial multiplexing rates corresponding to the number of antennas.

43. The apparatus of claim 42, wherein the plurality of spatial multiplexing rates comprise a pure diversity spatial multiplexing rate, a pure multiplexing spatial multiplexing rate, and one or more intermediate spatial multiplexing rates.

44. The apparatus of claim 37, wherein the mapping permutations are applied to the plurality of data tones in a cyclical manner.

45. The apparatus of claim 37, which is compliant with a standard selected from the group consisting of IEEE standards 802.11a, 802.11g, 802.16, and 802.20.

46. The apparatus of claim 37, wherein the space frequency coded symbols is coded using less than a plurality of available tone-antenna combinations.

47. The apparatus of claim 37, wherein the space frequency coded symbol includes one or more of the plurality of data symbols mapped to the plurality of antennas using the same mapping permutation for a plurality of adjacent tones.

48. A computer program comprising:

receiving a selected spatial multiplexing rate, the spatial multiplexing rate corresponding to one or more mapping permutations; and

for each of a plurality of data tones, mapping one or more of a plurality of data symbols to a plurality of antennas using a corresponding one of the one or more mapping permutations.

49. The computer program of claim 48, wherein the plurality of data tones comprise data tones in an OFDM (Orthogonal Frequency Division Multiplexing) symbol.

50. The computer program of claim 49, wherein said mapping comprises space frequency coding the OFDM symbol.

51. The computer program of claim 50, further comprising:

generating a signal to be transmitted on the plurality of antennas, said signal including the coded OFDM symbol.

52. The computer program of claim 48, wherein the plurality of mapping permutations comprise $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ mapping permutations, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

53. The computer program of claim 48, wherein the spatial multiplexing rate is selected from a plurality of available spatial multiplexing rates corresponding to the number of antennas.

54. The computer program of claim 53, wherein the plurality of available spatial multiplexing rates comprise a pure diversity spatial multiplexing rate, a pure multiplexing spatial multiplexing rate, and one or more intermediate spatial multiplexing rates.

55. The computer program of claim 48, wherein the mapping permutations are applied to the plurality of data tones in a cyclical manner.

56. The computer program of claim 48, wherein said mapping comprising mapping with an apparatus compliant with a standard selected from the group consisting of IEEE standards 802.11a, 802.11g, 802.16, and 802.20.

57. The computer program of claim 48, wherein said mapping provides substantially maximum spatial diversity for the selected spatial multiplexing rate.

58. The computer program of claim 48, further comprising:

generating a signal to be transmitted from the plurality of antennas at a substantially equal power for each of said plurality of antennas, said signal including the plurality of data symbols.

59. The computer program of claim 48, wherein said mapping comprises mapping said one or more of the plurality of data symbols to the plurality of antennas for each of

the plurality of data tones using less than a plurality of available tone-antenna combinations.

60. The computer program of claim 48, wherein said mapping comprises mapping the same mapping permutation to the plurality of antennas for a plurality of adjacent tones.

61. A computer program comprising:

receiving a space frequency coded symbol from a plurality of antennas, the space frequency coded symbol including a plurality of data tones,

wherein each data tone includes one or more of a plurality of data symbols mapped according to a corresponding one of one or more mapping permutations, and

wherein the one or more mapping permutations correspond to a selected spatial multiplexing rate; and

decoding the space frequency coded symbol.

62. The computer program of claim 61, wherein said decoding comprises decoding using a linear decoding process.

63. The computer program of claim 61, wherein said decoding comprises decoding using a non-linear decoding process.

64. The computer program of claim 61, wherein the space frequency coded symbol comprises a space frequency coded OFDM symbol.

65. The computer program of claim 61, wherein the plurality of mapping permutations comprise $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ mapping permutations, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

66. The computer program of claim 61, wherein the spatial multiplexing rate is selected from a plurality of spatial multiplexing rates corresponding to the number of antennas.

67. The computer program of claim 66, wherein the plurality of spatial multiplexing rates comprise a pure diversity spatial multiplexing rate, a pure multiplexing spatial multiplexing rate, and one or more intermediate spatial multiplexing rates.

68. The computer program of claim 61, wherein the mapping permutations are applied to the plurality of data tones in a cyclical manner.

69. The computer program of claim 61, wherein said receiving comprises receiving with an apparatus compliant

with a standard selected from the group consisting of IEEE standards 802.11a, 802.11g, 802.16, and 802.20.

70. The computer program of claim 61, wherein said receiving comprises receiving the space frequency coded symbol with substantially maximum spatial diversity on the antennas for the selected spatial multiplexing rate.

71. The computer program of claim 61, wherein said receiving comprises receiving the space frequency coded symbol at a substantially equal power for each of said plurality of antennas.

72. The computer program of claim 61, wherein the space frequency coded symbol includes a plurality of data symbols mapped according to one of the plurality of mapping permutations for a plurality of adjacent tones.

73. An apparatus comprising:

means for demultiplexing a plurality of data symbols in an input stream;

means for selecting a spatial multiplexing rate from a plurality of available spatial multiplexing rates, the selected spatial multiplexing rate corresponding to a plurality of data symbols and one or more mapping permutations; and

means for space frequency coding a symbol for transmission, said coding comprising, for each of a plurality of data tones, mapping one or more of the plurality of data symbols to a plurality of antennas using a corresponding one of the one or more mapping permutations.

74. The apparatus of claim 73, wherein symbol for transmission comprises an OFDM symbol.

75. The apparatus of claim 74, further comprising:

means for transmitting the coded OFDM symbol on the plurality of antennas.

76. The apparatus of claim 73, wherein the plurality of mapping permutations comprise $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ mapping permutations, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

77. The apparatus of claim 73, wherein the plurality of available spatial multiplexing rates comprise a pure diversity spatial multiplexing rate, a pure multiplexing spatial multiplexing rate, and one or more intermediate spatial multiplexing rates.

78. The apparatus of claim 73, wherein the coding module is operative to apply the mapping permutations to the plurality of data tones in a cyclical manner.

79. The apparatus of claim 73, which is compliant with a standard selected from the group consisting of IEEE standards 802.11a, 802.11g, 802.16, and 802.20.

80. The apparatus of claim 73, further comprising means for space frequency coding the symbol to provide substantially maximum spatial diversity for the selected spatial multiplexing rate.

81. The apparatus of claim 73, further comprising:

means for transmitting the symbol from the plurality of antennas at a substantially equal power for each of said plurality of antennas.

82. The apparatus of claim 73, further comprising means for space frequency coding the symbol using less than a plurality of available tone-antenna combinations.

83. The apparatus of claim 73, further comprising means for mapping one or more of the plurality of data symbols to the plurality of antennas using the same mapping permutation for a plurality of adjacent tones.

84. An apparatus comprising:

means for receiving a space frequency coded symbol from a plurality of antennas, the space frequency coded symbol including a plurality of data tones,

wherein each data tone includes a plurality of data symbols mapped according to a corresponding one of one or more mapping permutations, and

wherein the plurality of data symbols and the one or more mapping permutations correspond to a selected spatial multiplexing rate; and

means for decoding the space frequency coded symbol.

85. The apparatus of claim 84, wherein said means for decoding comprises a means for decoding using a linear decoding technique.

86. The apparatus of claim 84, wherein said means for decoding comprises a means for decoding using a non-linear decoding technique.

87. The apparatus of claim 84, wherein the space frequency coded symbol comprises a space frequency coded OFDM symbol.

88. The apparatus of claim 84, wherein the plurality of mapping permutations comprise $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ mapping permutations, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

89. The apparatus of claim 84, wherein the spatial multiplexing rate is selected from a plurality of spatial multiplexing rates corresponding to the number of antennas.

90. The apparatus of claim 89, wherein the plurality of spatial multiplexing rates comprise a pure diversity spatial multiplexing rate, a pure multiplexing spatial multiplexing rate, and one or more intermediate spatial multiplexing rates.

91. The apparatus of claim 84, wherein the mapping permutations are applied to the plurality of data tones in a cyclical manner.

92. The apparatus of claim 84, which is compliant with a standard selected from the group consisting of IEEE standards 802.11a, 802.11g, 802.16, and 802.20.

93. The apparatus of claim 84, wherein the space frequency coded symbols is coded using less than a plurality of available tone-antenna combinations.

94. The apparatus of claim 84, wherein the space frequency coded symbol includes one or more of the plurality of data symbols mapped to the plurality of antennas using the same mapping permutation for a plurality of adjacent tones.